

## High specific power and cost effective solar array for spacecraft, lighter than air vehicles, and UAVs

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### Description:

**OBJECTIVE:** Develop and demonstrate a 2 100 W radiation hardened solar array adaptable to nanosatellites exhibiting flexibility, variable topology, high specific power and low cost.

**DESCRIPTION:** Satellite power systems designs are trending towards "the large as possible" types of satellites with power system mass allocations of approximately 200 kg down to nanosatellites with volume constraints based on the "3U" concept requiring a 10 cm x 10 cm x 34 cm volume constraint. Both ends of this spectrum of satellite sizes have traditionally relied upon the use of high efficiency monolithic multijunction photovoltaic (PV) technologies to provide power to the electrical bus whose solar array specific power on the order of 80 100 W/kg, and cost rates for the solar array as high as \$350/W. The use of high efficiency solar cells to populate arrays limits overall power to approximately 30 kW for large satellite systems, and is reportedly and surprisingly a cost limiter for nanosatellite systems. In the interest of enabling substantial gains in power available to spacecraft, thin film photovoltaics will be considered in this topic. Recent technology advances in the area of thin film photovoltaic arrays offer a solution to the mass and stowable volume limitations of high power arrays. Thin film arrays, even with efficiencies of only around 9-12%, are so lightweight that they offer specific powers in excess of 1,000 W/kg - a factor of ten or more above the current state of the art for inorganic cells. Since these arrays are deployable, they can be packaged with minimum mass and volume, and readily deployed in space with near-term demonstrable technologies. In fact, laboratory test cells have been produced by Institut de Microtechnique at the University of Neuchatel, Switzerland using LaRCTM-CP1 thin-film substrates produced by SRS Technologies in

Huntsville, AL that have the highest power/mass ratio on record - 4300 W/kg![6] These thin film arrays can be stowed in a rolled or folded configuration in the launch vehicle and deployed in space by simple boom extension or roller mechanisms. A well-designed 50 kW space solar array and deployment system using rolled mechanisms with this specific power would weigh 32 kg with a payload volume the size of a suitcase. This low mass and payload volume, combined with high power density, can provide 50 kW+ space solar arrays at 25% of the cost of current rigid solar arrays. Regarding suitability to the space environment, recent AFRL test and characterization programs have shown that even organic-semiconductor-based photo-cells may be usefully employed as power sources in space, particularly for short-lifetime, rapidly-assembled, low earth orbit (LEO) missions. Though they too exhibit disadvantages over typical inorganic based cells (e.g., low photo-conversion efficiency (